

CLAIMS

What is claimed is:

1. A gravity dependent pedicle screw tap hole guide, comprising:
a guide shaft having a proximal end, a distal end, and a longitudinal axis, the guide shaft being maintainable parallel to a drill bit during the drilling of a pedicle screw tap hole with the drill bit;
a level indicator associated with a reference direction and being responsive to gravity to provide feedback regarding an angular difference between an acting direction of gravity and the reference direction; and
a mounting by which the level indicator is attached to the guide shaft, the mounting establishing a positional relationship between the reference direction and the longitudinal axis of the guide shaft.
2. The gravity dependent pedicle screw tap hole guide of claim 1, wherein the guide shaft is fixed to the level indicator by the mounting such that the longitudinal axis of the guide shaft is parallel to the reference direction.
3. The gravity dependent pedicle screw tap hole guide of claim 1, wherein the mounting is adjustable such that the longitudinal axis of the guide shaft is angulatable with respect to the reference direction.
4. The gravity dependent pedicle screw tap hole guide of claim 3, wherein the mounting has at least one indicator that is viewable to determine an angular difference between the longitudinal axis of the guide shaft and the reference direction.

5. The gravity dependent pedicle screw tap hole guide of claim 3, wherein the mounting comprises at least one rotational mounting between the guide shaft and the level indicator, the rotational mounting being engageable and disengageable at a plurality of positions including a parallel position and a plurality of rotated positions, the parallel position being a position at which the longitudinal axis of the guide shaft is parallel to the reference direction, each of the rotated positions being a respective position at which the longitudinal axis of the guide shaft is rotated with respect to the reference direction.

6. The gravity dependent pedicle screw tap hole guide of claim 5, wherein the mounting comprises first and second rotational mountings between the guide shaft and the level indicator, the first rotational mounting providing rotation of the longitudinal axis of the guide shaft relative to the reference direction in a first plane, the second rotational mounting providing rotation of the longitudinal axis of the guide shaft relative to the reference direction in a second plane, the second plane being perpendicular to the first plane, such that the parallel position of the first rotational mounting is a position at which the longitudinal axis of the guide shaft is parallel to the reference direction in the first plane, and the parallel position of the second rotational mounting is a position at which the longitudinal axis of the guide shaft is parallel to the reference direction in the second plane, each of the rotated positions of the first rotational mounting being a respective position at which the longitudinal axis of the guide shaft is rotated with respect to the reference direction in the first plane, and each of the rotated positions of the second rotational mounting being a respective position at which the longitudinal axis of the guide shaft is rotated with respect to the reference direction in the second plane.

7. The gravity dependent pedicle screw tap hole guide of claim 6, wherein each of the first and second rotational mountings has angle markers associated therewith that are viewable to determine an angular difference between the longitudinal axis of the guide shaft and the reference direction.

8. The gravity dependent pedicle screw tap hole guide of claim 1, wherein the level indicator comprises a fluid chamber that is partially filled with fluid such that a gas bubble is free to move in the fluid chamber through a plurality of positions including a position at which the reference direction is parallel to the acting direction of gravity and a plurality of positions at which the reference direction is angulated with respect to the acting direction of gravity, the fluid chamber having a wall through which the gas bubble is visible, the wall having a reference mark indicating the parallel position.

9. The gravity dependent pedicle screw tap hole guide of claim 8, wherein the fluid chamber comprises an enclosure having a convex surface and having a central axis parallel to the reference direction.

10. The gravity dependent pedicle screw tap hole guide of claim 8, wherein the enclosure has a plurality of relative marks indicating the angulated positions.

11. The gravity dependent pedicle screw tap hole guide of claim 10, wherein the wall comprises a grid establishing the reference mark and the relative marks.

12. The gravity dependent pedicle screw tap hole guide of claim 1, wherein the level indicator comprises an accelerometer.

13. The gravity dependent pedicle screw tap hole guide of claim 12, wherein the level indicator further comprises a readout adapted to indicate the angular difference.

14. A method of drilling a pedicle screw tap hole, comprising:
determining a trajectory angle as an angle of a pedicle in a reference plane relative to an acting direction of gravity;
positioning at least one of a distal end of a drill bit and a distal end of a guide shaft of a gravity dependent pedicle screw tap hole guide at a position adjacent the pedicle in a vicinity of a base of a superior articular process of the pedicle and a base and a middle of a transverse process of the pedicle, the guide having the guide shaft and a level indicator associated with a

reference direction, the level indicator being responsive to gravity to provide feedback regarding an angular difference between an acting direction of gravity and the reference direction, the guide having a mounting by which the level indicator is attached to the guide shaft, the mounting establishing a positional relationship between the reference direction and the longitudinal axis of the guide shaft;

angulating the guide shaft about the distal end of the guide shaft until the gravity dependent pedicle screw tap hole guide indicates that an angle between the longitudinal axis of the guide shaft in the reference plane and the acting direction of gravity matches the trajectory angle; and

rotating the drill bit into the pedicle along a trajectory extending into the pedicle from the position at the trajectory angle.

15. The method of drilling a pedicle screw tap hole of claim 14, wherein the trajectory angle is a first trajectory angle and the reference plane is a first reference plane, the method comprising:

determining the first trajectory angle as the angle of the pedicle in the first reference plane relative to the acting direction of gravity;

determining a second trajectory angle as an angle of the pedicle in a second reference plane relative to the acting direction of gravity;

positioning at least one of the distal end of the drill bit and the distal end of the guide shaft at the position;

angulating the guide shaft about the distal end of the guide shaft until the gravity dependent pedicle screw tap hole guide indicates that the angle between the longitudinal axis of the guide shaft in the first reference plane and the acting direction of gravity matches the first trajectory angle, and that an angle between the longitudinal axis of the guide shaft in the second reference plane and the acting direction of gravity matches the second trajectory angle; and

rotating the drill bit into the pedicle along a trajectory extending into the pedicle from the position at the first trajectory angle and the second trajectory angle.

16. The method of drilling a pedicle screw tap hole of claim 15, wherein the first reference plane is a cephalad-caudad plane defined by a vertebral body comprising the pedicle, and the second reference plane is a medial plane defined by the vertebral body.

17. The method of drilling a pedicle screw tap hole of claim 14, comprising:
determining the trajectory angle as the angle of the pedicle in the reference plane relative to the acting direction of gravity;
positioning the distal end of the guide shaft at the position;
angulating the guide shaft about the distal end of the guide shaft until the gravity dependent pedicle screw tap hole guide indicates that the angle between the longitudinal axis of the guide shaft in the reference plane and the acting direction of gravity matches the trajectory angle;
positioning the drill bit coaxial with the longitudinal axis of the guide shaft; and
rotating the drill bit into the pedicle along the trajectory extending into the pedicle from the position at the trajectory angle.

18. The method of drilling a pedicle screw tap hole of claim 14, comprising:
determining the trajectory angle as the angle of the pedicle in the reference plane relative to the acting direction of gravity;
positioning the distal end of the drill bit at the position;
maintaining the longitudinal axis of the guide shaft parallel to the drill bit while angulating the guide shaft about the distal end of the guide shaft until the gravity dependent pedicle screw tap hole guide indicates that the angle between the longitudinal axis of the guide shaft in the reference plane and the acting direction of gravity matches the trajectory angle; and
rotating the drill bit into the pedicle along the trajectory extending into the pedicle from the position at the trajectory angle.

19. The method of drilling a pedicle screw tap hole of claim 14, wherein determining the trajectory angle comprises:
establishing a vertical orientation of a clamp having a longitudinal axis by maintaining the longitudinal axis of the guide shaft parallel to the longitudinal axis of the clamp while

angulating the guide shaft about the distal end of the guide shaft until the gravity dependent pedicle screw tap hole guide indicates that the longitudinal axis of the guide shaft is parallel to the acting direction of gravity;

attaching the clamp in the vertical orientation to a spinous process of a vertebral body comprising the pedicle;

generating an image including the vertebral body while the clamp is attached; and

determining from the image an angular difference between the orientation of the pedicle and the orientation of the clamp.

20. The method of drilling a pedicle screw tap hole of claim 19, wherein determining the trajectory angle further comprises obtaining at least one of an MRI image of the vertebral body, a CAT image of the vertebral body, and a radiograph image of the vertebral body.